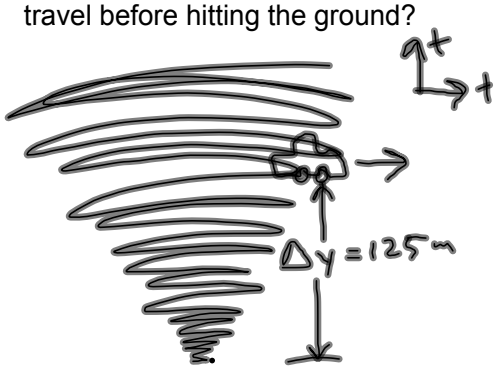
Projectile Motion Practice Problems 2.23.12 CP Physics

During a thunderstorm, a tornado lifts a car to a height of 125 m above the ground. Increasing in strength, the tornado flings the car horizontally with a speed of 9.0 m/s. How long does the car take to reach the ground? How far horizontally does the car travel before hitting the ground?



$v_{iy} = 0$ m/s

$v_{ix} = 9$ m/s

$a_g = -9.8$ m/s

a) $t = ?$

$$\Delta y = v_{iy} t + \frac{1}{2} a_g t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_g}}$$

$$= \sqrt{\frac{2(-125\text{ m})}{(-9.8\text{ m/s}^2)}}$$

$$= 5.05\text{ s}$$

b) $\Delta x = v_{ix} t$

$$= (9\text{ m/s})(5.05\text{ s})$$

$$= 45.5\text{ m}$$

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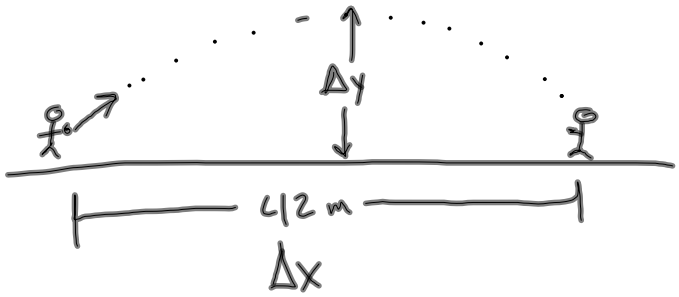
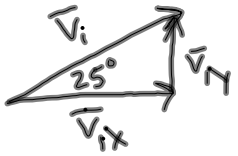
A baseball is thrown at an angle of 25 degrees relative to the ground at a speed of 23.0 m/s. If the ball was caught 42.0 m from the thrower at the same height it was thrown, how long was it in the air? How high above the thrower did the ball travel?





$V_i = 23\ m/s$

$V_Y = V_i \sin(25°)$

$= 9.72\ m/s$

$V_{ix} = V_i \cos(25°)$

$= 20.85\ m/s$

a) $t = ?$

$\Delta x = v_{ix} t$

$t = \frac{\Delta x}{v_{ix}} = \frac{42\ m}{20.85\ m/s} = 2.01\ s$

b) highest point is at half of Δx and half of time

we have to use $\frac{1}{2}t \cdot \frac{1}{2}(2.01\ s) = 1.005\ s$

$a_g = -9.8\ m/s^2$

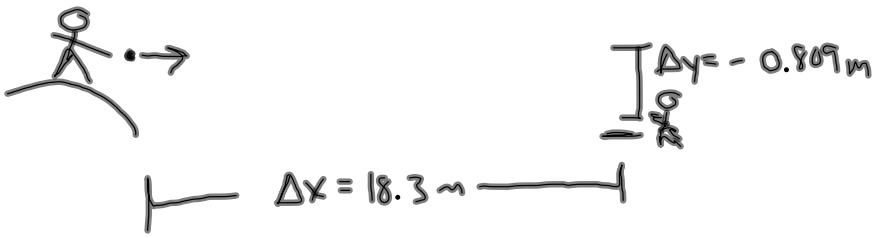
$\Delta y = v_Y t + \frac{1}{2} a_g t^2$

$= (9.72\ m/s)(1.005\ s) + \frac{1}{2}(-9.8\ m/s^2)(1.005\ s)^2$

$= 4.8\ m$

Projectile Motion Practice Problems 2.23.12 CP Physics

The fastest recorded pitch in Major League Baseball was thrown by Nolan Ryan in 1974. If this pitch were thrown horizontally, the ball would fall 0.809 m by the time it reached home plate, 18.3 m away. How fast was Ryan's pitch?



$V_{iy} = 0$ m/s $V_{ix} = ?$

$\Delta x = v_{ix} t$

$v_{ix} = \frac{\Delta x}{t} = \frac{18.3\text{ m}}{.406\text{ s}} = 45.08$ m/s

101 mph

Need to find time, so use an equation in the y-direction.

$\Delta y = v_{iy} t + \frac{1}{2} a_g t^2$

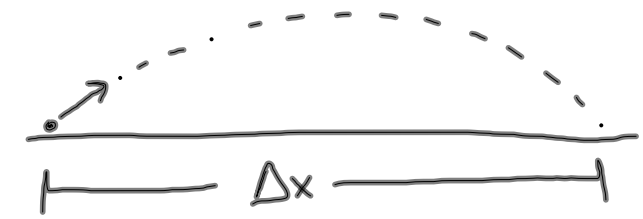
$t = \sqrt{\frac{2\Delta y}{a_g}}$

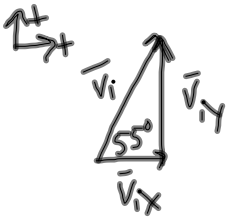
$= \sqrt{\frac{2(-0.809\text{ m})}{(-9.8\text{ m/s}^2)}}$

$= 0.406$ s

Projectile Motion Practice Problems 2.23.12 CP Physics

A shell is fired from the ground with an initial speed of 1.70E3 m/s at an initial angle of 55 degrees to the horizontal and returns to the ground. Neglecting air resistance, find
a) the shell's horizontal range.
b) the amount of time the shell is in motion.





$V_i = 1700\ m/s$

$V_{ix} = 975\ m/s$

$V_{iy} = 1392\ m/s$

*assumption to make is that $V_{fy} = -V_{iy}$, and we can make this assumption because the shell lands at the same height as it was fired from

b) $t = ?$ $\quad V_{fy} = -1392\ m/s$ $\quad a_g = -9.8\ m/s^2$

$$V_{fy} = V_{iy} + a_g t$$

$$t = \frac{V_{fy} - V_{iy}}{a_g}$$

$$= \frac{-1392\ m/s - 1392\ m/s}{-9.8\ m/s^2}$$

$$= 284\ s$$

a) $\Delta x = ?$

$$\Delta x = v_{ix} t$$

$$= (975\ m/s)(284\ s)$$

$$= 276900\ m$$